

Use of Virtual Exercise Environments for People with Disabilities

Jane Mulligan

Computer Science, University of Colorado at Boulder

Virtual reality (VR) can transport people to real or imagined worlds and allow them to meet or compete with friends in distant locations. As a result it offers a unique approach to addressing the exercise needs of people with physical and cognitive disabilities. The goal of this project is to develop and distribute compelling augmentations for cardiovascular exercise equipment, such as treadmills, stationary bikes, or arm ergometers, which can engage users and increase enjoyment and participation in regular exercise programs.

The augmentation we have developed in the first round of the NIDRR Rehabilitation Engineering Research Center for Recreational Technologies and Exercise Physiology Benefiting Persons with Disabilities (RecTech) takes the form of a Virtual Exercise Environment (VEE) which makes the user feel immersed in a recorded trail environment. The VEE consists of a target exercise machine, audio and video displays, and a workstation to drive the displayed percepts. In the initial phase of the project our work included the development of novel recording techniques to capture video and physical trail properties such as tilt and distance. The VEE display system renders immersive surround (panoramic) video in a Head Mounted Display (HMD) while tracking head position so the user can "look around" at all sides. The system also modifies resistance (bikes and ergometers) or tilt (treadmills) according to recorded properties of the trail.

What distinguishes the VEE from other systems which integrate displayed games and graphics for exercise equipment (<http://www.fitcentric.com/>, <http://www.expressofitness.com/>) is that our system employs a capture phase which records real trails for playback. For most VR or game augmented exercise machines the machine itself acts only as an input device, like a joystick or a mouse. In the case of the VEE we also play back physical trail features using machine resistance, so that it acts as an output device or display as well.

In our ongoing work we are adding a network connection which will allow participants at different locations to ride "together" by downloading the same trail recording. VEE software will synchronize the progress of the users, and provide a Voice over IP link so they can chat as they work out along the same course. This social interaction is critical for participants who may have difficulty accessing a park or fitness center, since exercising with a buddy is also known to increase adherence and enjoyment.

The focus of the VEE project in the next round of RecTech is refining the technology, enhancing the virtual experience, and developing a delivery system to make it available to the public. The technical enhancements include a spatial map or more gamelike geometry where the user can explore various routes through the virtual space rather than viewing playback of a fixed trail sequence. As the project progresses we will investigate other immersive representations which exploit our Multiview image data for reconstruction or texture mapping in gamelike environments.

We are working to build and deliver VEE technology which is low in cost yet effective in producing engaging, immersive contexts for participating in beneficial exercise. Our ultimate goal is to freely distribute our software and trail data from a publicly accessible Internet server so that interested participants around the world will be able to download and engage in cooperative or competitive exercise in a rich variety of recorded contexts.